# LARGE DIAMETER SUPPLY HOSE: IS IT APPROPRIATE FOR THE TEXARKANA FIRE DEPARTMENT?

EXECUTIVE ANALYSIS OF FIRE SERVICE OPERATIONS IN EMERGENCY MANAGEMENT

BY: Harry H. Simms
Fire Chief
Texarkana Fire Department
Texarkana, Texas

An applied research project submitted to the National Fire Academy
as part of the Executive Fire Officer Program

October 1997

## Abstract

The Texarkana, Texas, Fire Department had experienced a problem with delivering an adequate amount of water to larger fires. One well-known solution to this problem, which had been widely adopted by fire departments, was the use of large diameter hose (LDH). The purpose of this research project was to evaluate whether changing to large diameter supply hose is an appropriate strategy for the Texarkana Fire Department.

This study used an evaluative research methodology to answer the following research questions:

1. What are the advantages of large diameter supply hose as compared to the supply hose currently used by the department?
2. What are the disadvantages of large diameter supply hose as compared to the supply hose currently used by the department?
3. What equipment and adapters are needed to properly utilize large diameter hose?
4. Are there any safety concerns with the use of large diameter hose?
5. How does the cost of large diameter hose compare to the cost of an equivalent amount of the supply hose currently used?
6. Should the Texarkana Fire Department convert to large diameter supply hose?

Through use of a literature review, a demonstration, and a survey of participants, the research questions were answered. Based on the findings of the study, a transition to large diameter supply hose was found to be an appropriate strategy for the Texarkana Fire Department and the following recommendations were made:

1. The Texarkana Fire Department should begin a program to replace all 3 inch supply hose with 5 inch large diameter supply hose, completing the replacement program prior to the next scheduled ISO inspection in 1999, if possible under budgetary constraints.
2. A standard operating procedure for use of 5 inch hose should be developed.
3. A training program for all personnel should be developed and delivered prior to placing the large diameter supply hose in service

# Table Of Contents

## Introduction

The Texarkana, Texas, Fire Department has experienced a problem with delivering an adequate amount of water to larger fires. This has been experienced at major fires and is reflected in the current Insurance Services Organization (ISO) rating. The city's water supply is generally acceptable, but delivery of water from the source to the fire has not been adequate. One well-known solution to this problem that has been widely adopted by fire departments is the use of large diameter supply hose (LDH). The purpose of this research project is to evaluate whether changing to large diameter supply hose is an appropriate strategy for the Texarkana Fire Department.

This study will use an evaluative research methodology to answer the following research questions:

1. What are the advantages of large diameter supply hose as compared to the supply hose currently used by the department?
2. What are the disadvantages of large diameter supply hose as compared to the supply hose currently used by the department?
3. What equipment and adapters are needed to properly utilize large diameter hose?
4. Are there any safety concerns with the use of large diameter hose?
5. How does the cost of large diameter hose compare to the cost of an equivalent amount of the supply hose currently used?
6. Should the Texarkana Fire Department convert to large diameter supply hose?

## Background and Significance

The Texarkana, Texas, Fire Department serves a population of approximately 34,000 citizens with a service area of approximately 25 square miles. The entire service area is urban in nature with adequate water mains and hydrant distribution. All water supply for structure fires is obtained from hydrants, with no water tenders or suction supplies. The department operates five fire stations with five engine companies, one truck company, and one rescue company. The Texarkana Fire Department is a career department with 73 uniformed and 2 civilian employees. Daily staffing in the operations division ranges from a minimum of 18 personnel to a maximum of 20. All engines are equipped with 1,000 gallon per minute (gpm) or larger pumps. Currently, the department uses 3 inch supply / attack hose with 2 ½ inch couplings for water supply. The hose is carried in a split hose bed with 800 feet of hose in each side, making a total of 1,600 feet of supply hose on each engine. The hose is loaded for forward lays with adapters used for reverse lays. Either one 1,600 foot line or two 800 foot lines can be laid.

Two specific problems led this department to consider changing our supply hose. First, a large commercial fire last year became heavily involved in flame prior to the department's arrival. The building was an old supermarket that had been converted to a furniture store. It was approximately 7,500 square feet with a heavy fire load and anchored one end of a large "L" shaped strip mall. There was an intact fire wall between this building and the adjacent strip mall which helped contain the fire to the occupancy of origin. Three hydrants were available within 800 feet for water supply and all three were rated to flow in excess of 1,000 gallons per minute. One of the hydrants was less than 200 feet from the fire building. All three hydrants were used for the fire with three engines pumping. One 1,250 gpm engine spotted at a hydrant and pumped through two 3 inch lines of 800 feet each to supply an aerial master stream. One 1,000 gpm engine was operated with two forward laid 3 inch lines of 200 feet each. This engine supplied an engine mounted master stream device as well as some hand lines. The third engine (1,250 gpm) was supplied by two forward laid 3 inch lines of 800 feet each. This engine supplied hand lines only. The fire was eventually extinguished after the fuel load was reduced to match the water being applied. Through post-incident analysis, the department identified water supply as a problem. The National Fire Academy formula for fire flow showed a needed fire flow of around 2,500 gallons per minute to extinguish this fire. The three engines pumping had a combined pump capacity of 3,500 gallons per minute. The three available hydrants had in excess of 3,000 gpm available. Master stream devices and personnel were available to flow well in excess of the needed flow. If all available water has been delivered to the fire scene, the fire could have been extinguished more rapidly. While other strategies to deal with the problem were identified in the critique, use of large diameter hose was identified as one potential solution that could not be implemented just through training and changing operational procedures.

The second problem that led to the department's consideration of large diameter hose was a recent change made by the Texas Department of Insurance (TDI) in regard to insurance ratings. For 80 years, the State of Texas has used the Key Rate Schedule as the insurance rating system for fire departments. On September 11, 1996, the Key Rate Schedule was repealed by the Insurance Commissioner and the Insurance Service's Office (ISO) Public Protection Classification system was adopted, to be effective January 1, 1997 ("TDI adopts ISO's fire suppression rating schedule", 1996). Prior to this date, municipal fire departments in Texas had been rated on the ISO system, but these ratings were used only by insurance companies to make underwriting decisions. They were not used in rate calculations. The Texarkana Fire Department, like other fire departments in Texas, had based many procedures on requirements of the Key Rate Schedule. The department was now faced with a transition to a different schedule and wanted to maximize the credit available to improve our ISO rating. One of the major factors in the ISO schedule is water supply with a weight of 40%. Of the 40 points available for water supply, 35 are based on a comparison of the needed fire flow to the capacity of the supply works, the capacity of the distribution system (water mains), and the combined capacity of all fire hydrants within 1,000 feet of the location being tested. Whichever of these four factors limits the water available or needed limits the credit. Under ISO guidelines, hydrants within 300 feet of the test location are credited at 1,000 gpm. Those from 301 to 600 feet away are credited at 670 gpm. Those from 601 feet to 1,000 feet away are credited at 250 gpm. Hydrants more than 1,000 feet from a test point receive no credit (Hickey, 1993). In Texarkana, hydrants are most commonly the limiting factor in the water supply calculations and, at our last rating, the water supply portion received only 23 of the 35 points available. According to Stevens (1996), full credit for hydrants to 1,000 feet can be given to departments who carry at least 1,000 feet of large diameter hose. This was confirmed by Michael Pietsh, PE, a Senior Field Engineer for ISO, at a seminar attended by the author (personal communication, May 30, 1997).

Because large diameter hose has the potential to improve water supply at larger fires and because of the need to improve the department's ISO rating, this study is relevant to the department. This study is relevant to this Executive Fire Officer course, Executive Analysis of Fire Department Operations in Emergency Management. It specifically relates to Unit 2, Emergency Operations, to the preparation phase of the standard emergency management cycle, and to capability assessment as discussed in Unit 1.

# Literature Review

## Advantages

A survey of available literature was conducted to answer some of the research questions and to provide a background for further research. National Fire Protection Association (NFPA) 1961, “Standard on Fire Hose”, defines large diameter hose as hose with an inside diameter of 3 ½ inch or larger. Large diameter supply hose is designed to be used at a normal operating pressure of 185 pounds per square inch (psi). Large diameter attack hose is designed for use at operating pressures of at least 275 psi (NFPA 1961, 1992). This study deals with large diameter supply hose, not attack hose. The two sizes of large diameter supply hose most commonly used by municipal fire departments are 4 inch and 5 inch, although 6 inch is also available (Clark, 1991). The primary advantage of large diameter hose is that it will deliver more water than will smaller hose under the equivalent conditions of supply and pressure. One study showed two 2 ½ inch hoses of 300 feet each delivering 700 gpm to a pumper. From the same hydrant, one 5 inch hose 300 feet in length delivered 1,840 gpm (Shapiro, 1997). The same is true between sizes of large diameter hose. Another study by Shapiro (1996b) used equal 300 feet lengths of 4 and 5 inch hose to supply a pumper. The 4 inch hose supplied 1,057 gpm while the 5 inch hose supplied 1521 gpm. Another author compared flow in various hose sizes based on the amount of water that could be flowed through 500 feet of hose with 60 psi static pressure available at the hydrant. He based his calculations on limiting friction loss to 10 psi per 100 feet of hose and leaving 10 psi suction pressure at the pump. Under these conditions, 2 ½ inch hose will deliver 220 gpm, 3 inch will deliver 350 gpm, 4 inch 710 gpm, and 5 inch will deliver 1,120 gpm (Edwards, 1995). Purrington (1991) lists low friction loss as the primary advantage of large diameter supply hose. This lower friction loss leads to the increased flows discussed above.

Another advantage of large diameter hose is that it will deliver water to the fireground with fewer people and less time necessary for set-up. Edwards (1995) describes a method of fully supplying a 1,000 gpm pumper with multiple reverse lays of 2 ½ inch hose. He describes these evolutions as "time consuming and sometimes operationally ineffective" (p. 48). This technique also requires an additional pump operator at the hydrant, which can be detrimental when modern staffing levels are considered.

**Disadvantages**

Some disadvantages to large diameter hose are listed in the literature. Purrington (1991) states that large diameter hose can be difficult to physically handle but that this disadvantage is overshadowed by the advantages. McGraw (1994) described the lower operating pressure in large diameter supply hose as a disadvantage in certain circumstances. He recommended that it not be used, in most cases, to supply standpipes and sprinkler systems in taller buildings as the 185 psi operating pressure of the hose is not adequate to overcome the friction loss in the system and the pressure loss due to elevation while maintaining an adequate nozzle pressure. Another disadvantage of large diameter supply hose is that use of this hose requires additional hardware. NFPA standard 1962, "Care, Use, and Service Testing of Fire Hose Including Couplings and Nozzles", 1993 edition, requires a pressure and volume relief device on the discharge side of the pump when supplying attack lines, manifolds, standpipes, and sprinkler systems. The same standard also requires an intake relief valve on a receiving pumper when large diameter supply hose is used in a relay operation. Shapiro (1996b) lists some comments he has heard regarding large diameter hose that could be described as disadvantages. He neither substantiates nor denies these statements but lists them only as comments. One of these comments is that large diameter hose is exceptionally heavy once charged and cannot be moved. A typical section of 5 inch hose 100 feet long weighs around 110 pounds and holds approximately 1 gallon of water per linear foot of hose. This yields a total weight of just over 940 pounds per 100 feet of charged hose. A similar section of 4 inch hose would weigh around 710 pounds per 100 feet charged. It is likely that these hoses would be difficult to move. The second comment is that large diameter hose is difficult to drive over once charged and can restrict access to the fire scene. Clark (1991) states that there have been several cases of damage to large diameter supply hose when cars were driven over a charged line. Clark states: "In some instances, the undercarriage of the car cut or abraded the hose. A burst in the major - or only - supply line can have serious consequences at a fire" (1991, p. 259).

**Equipment and Adapters**

As indicated above, NFPA 1962 requires certain relief devices when large diameter supply hose is used. Paragraph 2-1.6.2 of this standard states:

> A pressure and volume relief device with adequate capabilities and a maximum setting, not to exceed the service test pressure of the hose being used, shall be used on the discharge side of the pump when large diameter supply hose is used to supply attack lines, manifolds, and standpipe and sprinkler systems. Rapid closing or opening valves shall not be used with large diameter supply hose.

Paragraph 2-1.6.3 of this same standard also requires a suction relief valve on the receiving pumper if large diameter supply hose is used in a relay operation.

The number and type of adapters needed is affected by the choice of couplings. One common choice in large diameter supply hose systems is the quarter turn Storz coupling. An advantage of the Storz coupling is that it is a sexless coupling, having no male or female end. This reduces the number of adapters needed and eliminates the consideration of which way to load a hose bed, either for forward or reverse lay. Hose with Storz couplings is automatically ready to lay in either direction. A disadvantage of Storz couplings has been a tendency to become disconnected due to the natural tendency of large diameter hose to twist when charged. This has been largely eliminated on newer couplings by the inclusion of a locking device on the coupling. This tendency to twist also necessitates a swivel coupling at the point of connection to the engine to prevent the hose from twisting itself closed. National Standard Thread (NST) couplings can also be used on large diameter supply hose. They do not tend to disconnect with twisting as the twisting is in the tightening direction of the coupling. They do require a swivel at the point of connection to the engine to prevent the twisting from closing off the hose. NST couplings also tend to leak more than do Storz couplings (Shapiro, 1996a).

An intake relief valve is also a recommended appliance for use with large diameter supply hose, even on pumpers equipped with internal suction relief valves. This is recommended because the internal relief valve provides no protection when a line is being charged with the suction intake valve closed. An intake relief valve should have five features: an air bleeder; an internal, slow operating water valve; a pressure dump valve; a 30 degree elbow; and a swivel and locking device (Shapiro, 1996a). Peters (1994) also recommends external intake relief valves even though the pumper is equipped with an internal suction relief valve. He states that the internal relief valves may not respond quickly enough, a relief device is needed before the intake valve, and that the internal relief valves will adjust up to 250 psi as justification for his recommendation.

In some situations, a hydrant relay valve may be necessary. This is a valve that allows a pumper to connect to a hydrant and a supply line already in operation and boost pressure without interrupting the water flow. This is normally needed when long hose lays, large fire volume, or low hydrant pressures are common and 4 inch hose is used. Cities that have an average hydrant system and use 5 inch hose will probably not need a hydrant relay valve (Shapiro, 1996a).

Various adapters will be needed to adapt the large diameter hose thread chosen to existing pump and hydrant hose connections. The exact adapters needed will have to be determined by existing local conditions, the type of large diameter hose couplings chosen, and standard operating procedures adopted. Other accessories that might be used include siamese valves, LDH spanner wrenches, and hose rollers to remove water from hose before reloading (Shapiro, 1996a).

**Safety Concerns**

Peters (1994) specifically addressed large diameter hose safety. He cites one example of a gate valve failure that occurred as large diameter supply hose was being charged during a drill. The gate valve failed in the area between the gate and the swivel, striking the pump operator and causing serious injuries. In the course of investigation, a second identical valve was connected in the same manner as the valve that failed, and this valve also failed in the same location. The valves involved in this were simple upright gate valves, not pressure relief devices. It appeared that the valves were used as intended, but there was a failure anyway. At the time of the article, the cause of the failure had not been determined and no further information was being released due to pending litigation. Peters also cites another example of a woman being injured when a large diameter hose became disconnected and struck her during a major fire. He also recommends several safety precautions when using large diameter hose. First, pump operators should be properly trained to never exceed the normal operating pressure rating of the hose when pumping through large diameter supply hose. This pressure is 185 psi for most large diameter supply hose but is 135 psi for 6 inch hose. Second, valves should be operated slowly to prevent water hammer. Pumper fire apparatus built according to the 1991 or later edition of NFPA

1901 has built in protection as all valves 3 inch or larger must have valve actuating mechanisms that will not open or close the valves in less than three seconds. However, older pumpers will not have this protection, and pump operators must be aware of this danger and be trained to operate valves appropriately. Third, discharges that feed large diameter supply hose should be equipped with pressure and volume relief devices. This has been discussed previously in this literature review. Fourth, Peters recommends the previously discussed intake relief valves as a safety feature. Fifth, he recommends locating large diameter discharges and intakes away from the pump operator's panel, when possible, to prevent a hose or valve failure from injuring the pump operator. Sixth, he recommends using strain relief devices to prevent kinks in hoses at pumper connections. The 30 degree elbows mentioned by Shapiro (1996b) in conjunction with the intake pressure relief devices would fulfill this function. Last, Peters recommends locking devices on all quarter turn couplings. This is also an NFPA requirement, effective August 20, 1993. Older hose may not have these locking devices but can be retrofitted in some cases.

McGraw (1994) also cites pumping large diameter supply hose at too high a pressure, particularly when supplying standpipe systems in taller buildings, as a safety concern. He recommends training operators to never pump large diameter supply hose at more than its rated operating pressure and making arrangements to use other types of hose when higher pressures must be used. He also cites the need for pressure and volume relief devices on discharge outlets feeding large diameter supply hose.

Another safety concern is the method commonly used to load large diameter hose. NFPA 1500, "Standard on Fire Department Occupational Safety and Health Program", lists three exceptions to a general rule that all firefighters should be seated with seat belts fastened while an apparatus is in motion. One of these exceptions is during hose loading operations. Large diameter hose is commonly loaded by driving over or alongside the hose while firefighters on the apparatus load the hose. This is allowed by NFPA 1500 with the following provisions: (a) There must be a standard operating procedure covering this practice, (b) there must be a safety observer not involved in the hose loading process, (c) all non-fire department traffic must be excluded from the area, (d) the apparatus must be driven forward only at a speed not exceeding 5 miles per hour, and (e) no member shall stand on the tailstep, sidestep, running board, hose bed, or any other exposed position while the apparatus is in motion (Teele and Roche, 1993).

**Cost**

Another factor to be considered in adopting large diameter supply hose as a department standard is the cost of this hose. One method of comparing costs of various hose sizes is to compare the cost of the amount of hose necessary to move a specified quantity of water (Cottet, 1995). Edwards (1995) compared the water carrying capacity of various hose sizes based on a 60 psi hydrant and a hose lay of 500 feet. He states that 3 inch hose will supply 350 gpm under these conditions and 5 inch hose will supply 1,120 gpm. To fully supply a 1,000 gpm pumper would require three lengths of 3 inch hose and one length of 5 inch hose. The author obtained prices from a local vendor to compare equivalent costs. To supply 1,000 gpm under this theoretical scenario would require 1,500 feet of 3 inch hose costing approximately $4,800 or 500 feet of 5 inch hose costing approximately $2,450. While 5 inch hose is more costly per section, less hose is needed to accomplish the same purpose so the overall cost is lower.

**Summary**

Large diameter supply hose has several advantages, but the primary advantage is lower friction loss which results in greater water flow than smaller hose under equivalent conditions. There are some disadvantages to large diameter supply hose, as well as some safety concerns, but these can be overcome with proper procedures, equipment, and training. The literature review influenced this study specifically in the selection of which hose to consider. Several authors compared the flow characteristics of various sizes of hose and 5 inch hose flowed significantly better than 4 inch. Shapiro (1996a) specifically compared 4 inch and 5 inch hose and showed that 5 inch hose could deliver significantly more water. Edwards (1995) recommended sizing hose to fully supply your pumpers under most conditions. Since all Texarkana Fire Department pumpers are rated at 1,000 gpm or more, 1,000 gpm was chosen as the flow to use for comparisons. If 4 inch hose were to be used, multiple lines would have to be laid to supply 1,000 gpm under most conditions. Based on these considerations, this study concentrated on 5 inch hose.

## Procedures

The research questions in this study were answered through the use of a literature review, a demonstration, and a subsequent survey of participants. The demonstration and survey are described here.

### Demonstration

In discussion with the department about the advantages and disadvantages of changing to large diameter supply hose, some members expressed a desire to see this hose demonstrated and to actually use, load, and handle the hose themselves in order to make a judgment about its appropriateness for our department. To accomplish this, a demonstration was set up with the cooperation of the Paris, Texas, Fire Department. Paris Fire Department had used 5 inch hose for several years and was willing to demonstrate its use and allow Texarkana Fire Department members to perform hands-on evolutions to assist in the department's evaluation. The members selected to participate (described under Population heading below) traveled to the Paris Fire Department training facility and assisted their department with deploying the hose, operating master streams, emptying the hose, and reloading it on the engine. Members participating also had informal discussions with Paris Fire Department personnel and obtained their opinions regarding use of the hose, its advantages, and disadvantages. Following the demonstration, the members were surveyed for their opinions through use of the survey instrument described below.

**Population**

All members participating in the demonstration were surveyed. Members were selected for participation in the demonstration based upon their volunteering to participate. When the demonstration was scheduled, all members of the department were given the option to request to participate. Eight members volunteered, and all participated. The department has 72 uniformed personnel below the rank of chief, so the sample represents approximately 11% of the department. All ranks within the department were represented. The author viewed the demonstration but did not participate in the survey.

**Instrumentation**

A survey was developed by the author to distribute to the participants. The survey addressed the research questions except for the questions regarding adapters and cost. This information was not readily available to participants in the survey. Because the overall opinion within the department toward this change appeared to be negative, a question was included to measure attitudes toward the proposed change both before and after the demonstration. This item was intended to indicate whether the overall resistance could be overcome with training and actual usage. Also included were items to indicate rank and tenure. A sample survey can be viewed in the appendix.

### Collection of Data

Surveys were distributed by the author to all participants and were returned through intra-department mail. After the surveys were returned, the results were compiled by the author.

### Assumptions and Limitations

The author assumed that all respondents answered the survey honestly. The sample size was limited for two reasons. First, the demonstration involved a full day out of town trip so the inclusion of additional personnel was not possible. Second, only eight personnel volunteered to participate in the demonstration. It is also assumed that the participants were reasonably open-minded toward the proposed change, regardless of their initial opinion.

## Results

### Response Rate

Eight personnel participated in the demonstration and survey. All eight returned the surveys for a response rate of 100 per cent.

### Participants

One firefighter, three driver-engineers, three captains, and one battalion chief participated in the study. Of those participating, one had a tenure of less than 5 years, two had tenure of 6 to 10 years, two had 11 to 15 years, and three had more than 15 years. This represents all ranks in the department other than the department head and there was a reasonable representation of senior and less senior employees.

### Advantages

All participants listed increased water supply as an advantage of the 5 inch hose. The second most frequently listed advantage was the Storz couplings. These couplings are also available on smaller hose but are not currently used in this department. Also listed as advantages were less hose used (no dual lays), simplified decision making (one or two lines, forward or reverse lay), less personnel and equipment needed as compared to reverse lays, and one 5 inch hose easier to load than two 3 inch hoses.

The major advantage listed by participants is also the major advantage listed in the literature. Large diameter supply hose has less friction loss than smaller hose and will deliver more water to the fireground under equivalent conditions. The literature also noted the advantage of fewer personnel and less equipment needed to obtain maximum flows.

### Disadvantages

Six out of eight participants listed difficulty in moving charged hoses as a disadvantage in using 5 inch hose. Three listed difficulty in convincing the department of the value of the 5 inch hose as a disadvantage. Other disadvantages listed were that 5 inch hose cannot be driven over, that existing engines might have to be altered to accommodate the larger hose, that the 5 inch hose is harder to drain, and that rounding sharp corners with 5 inch hose might be difficult. One participant could see no disadvantages to the 5 inch hose.

Weight of the hose is also noted in the literature as a disadvantage. In addition, the literature lists lower operating pressure, necessity of additional hardware, and difficulty in driving over hose as potential disadvantages.

**Equipment and Adapters**

This research question was answered through the use of a literature review only. The literature recommended relief devices on both the suction and discharge sides of the pump when using large diameter supply hose, locking swivel fittings to overcome a twisting tendency in the hose, slow opening valves, possibly a hydrant relay valve, and adapters and fittings to meet local needs.

**Safety Concerns**

Four of the eight respondents could see no safety concerns at all that would be different from those with the existing hose. One listed 5 inch hose as a safety advantage in that more water could be available more quickly. The other respondents listed the weight of the hose (charged or empty) as a safety concern due to the possibility of lifting injuries. The only other danger listed was an increased tripping hazard due to the increased hose diameter.

The literature listed several more safety concerns than were identified by the study participants. Proper training in the recommended operating pressure of the hose and proper valve operation is indicated. Relief devices should be used where indicated and intake and discharge fittings should be located appropriately.

**Cost**

The issue of cost was addressed only through literature review and consultation with a fire equipment supplier to obtain cost information. While 5 inch hose is more expensive per foot than 3 inch hose, it is less expensive when the amounts of hose necessary to accomplish the delivery of 1,000 gallons per minute are compared.

**Overall Opinion**

The last two survey questions dealt with the attitude of respondents toward the possibility of changing to 5 inch hose prior to and after participating in the demonstration. Respondents were given four choices to describe their opinion: (a) Totally opposed; (b) generally against, but open to discussion; (c) possibly a good idea, but not completely convinced; and (d) definitely a good idea. Four respondents described their opinion as generally against, but open to discussion prior to the demonstration. The other four respondents described their opinion as possibly a good idea, but not completely convinced. All eight participants described their opinion as definitely a good idea after participating in the demonstration.

## Discussion

The findings of this study are consistent with the findings of others in the literature. The study participants perception of the advantages and disadvantages of large diameter supply hose were consistent with those found in the literature. More safety concerns were noted in the literature than were recognized by the participants. This may indicate a need for more training on the potential dangers of using large diameter supply hose if this department does convert. Of particular interest to the author was the change in attitude of the participants after being exposed to the actual use of large diameter supply hose. Prior to the demonstration, the participants were evenly split as to the wisdom of adopting this change in this department, but none supported the idea completely. After the demonstration, the participants all felt that this change was a good idea for the department. Prior to the demonstration, several department members mentioned difficulty in loading as one objection to the use of large diameter supply hose. After the demonstration, four participants listed ease in loading as an advantage of 5 inch hose.

From an organizational perspective, the use of 5 inch large diameter supply hose on all engine companies will address the problems noted in the introduction to this study. More water will be delivered to the fire scene than can currently be done with 3 inch hose. The ISO credit for water supply should be improved. Resistance within the department to this change must be overcome, but this study seems to indicate that most personnel can be convinced of the merits of the change through use of the hose.

## Recommendations

Based on the findings of this study, the author makes the following recommendations:

1. The Texarkana Fire Department should begin a program to replace all 3 inch supply hose with 5 inch large diameter supply hose. Due to budgetary considerations, this replacement program will have to be done on a gradual basis. By converting two existing pumpers per year and ordering the two pumpers anticipated to be purchased in the next two years with 5 inch hose, the replacement program should be completed prior to the next scheduled ISO inspection in 1999.

2. A standard operating procedure for use of 5 inch hose should be developed which includes consideration of the safety concerns identified in this study. Practical aspects of usage of the hose should also be addressed in the procedure.
3. A training program for all personnel should be developed and delivered prior to placing the large diameter supply hose in service. This training program should address safety and practical aspects of usage of 5 inch hose as well as the standard operating procedure to be developed.

# REFERENCES

Clark, W. E. (1991). Firefighting Principles and Practices (2nd ed.). Saddle Brook, NJ : Fire Engineering Books and Videos.

Cottet, J. L. (1995, June - July). We don't need LDH here. Firefighter's News, 13 , 28-29.

Edwards, C. B. (1995, February). Don't play supply hose catch-up. Fire Engineering, 148, 48-50.

Hickey, H. E. (1993). Fire suppression rating schedule handbook. Boston :Society of Fire Protection Engineers.

McGraw, B. M. (1994, October). When bigger isn't better. Fire Engineering, 147, 77-80.

National Fire Protection Association. (1992). Standard on fire hose (Standard No. 1961). Quincy, MA.

National Fire Protection Association. (1993). Standard for the care, use, and service testing of fire hose including couplings and nozzles. (Standard No. 1962). Quincy, MA.

Peters, W. C. (1994, April). LDH safety: It's no accident. Fire Engineering, 147, 63-68.

Purrington, R. G. (1991). Fire streams. In A. E. Cote & J. L. Linville, (Eds.), Fire Protection Handbook (pp. 5-103 to 5-114). Quincy, MA: National Fire Protection Association.

Shapiro, P. (1996a, April / May). Designing an LDH water delivery system. Firefighter's News, 14, 36-38.

Shapiro, P. (1996b, February / March). You decided LDH is for you - what should you buy?. Firefighter's News, 14, 33-36.

Shapiro, P. (Narrator). (1997, August). Layin' the big line, part 3:Maximizing flows with large diameter hose [Satellite broadcast]. Carrollton, TX: Fire & Emergency Television Network.

Stevens, Larry H. (1996, August / September). Water works: Get the most out of your hydrants. Firefighter's News, 14, 37-39.

TDI adopts ISO's fire suppression rating schedule. (1996, October). Newsline: Texas commission on fire protection, 5, 1

Teele, B. W., & Roche, K. (Eds.). (1993). NFPA 1500 Handbook. Quincy, MA: National Fire Protection Association.

# Appendix

## Survey Distributed To Study Participants

## Survey Distributed To Study Participants

TO: Personnel involved in 5” Hose Study

FROM: Harry H. Simms, Fire Chief

DATE: April 14, 1997

SUBJECT: Evaluation of 5” Hose

As a participant in the testing and evaluation of the large diameter supply hose we conducted in Paris, I am interested in your opinion. Please take the time to complete the following survey regarding your impressions of the demonstration. In order to make an informed decision on this matter, I need as much input as possible. Please complete each question as completely as possible, using the back of the form if necessary. Thank you for your assistance.

1. Please indicate your rank (circle one): FF DE Capt BC

2. Please indicate your tenure in this department (circle one):

   less than 5 years 6-10 Years 11-15 Years more than 15 Years

3. What do you see as the advantages of the 5” hose as compared to the 3” supply hose we are currently using?

4. What do you see as the disadvantages of the 5” hose as compared to the 3” supply hose we are currently using?

5. What potential safety concerns would you anticipate with a change to large diameter hose?

6. Prior to this demonstration, which of the following statements would have best described your opinion of this department converting to large diameter supply hose?

    a. Totally opposed.

    b. Generally against, but open to discussion.

    c. Possibly a good idea, but not completely convinced.

    d. Definitely a good idea.

7. After this demonstration, which of the following statements would have best described your opinion of this department converting to large diameter supply hose?

    a. Totally opposed.

    b. Generally against, but open to discussion.

    c. Possibly a good idea, but not completely convinced.

    d. Definitely a good idea.